

Beta Solenoid Proteins as Material Building Blocks

Daniel Cox^{1,*}, Xi Chen², J Hihath³, G-Y Liu², T Powers⁴, RRP Singh¹, M Toney², G Zimanyi¹, NR Hayre¹, A Karsai², K. Ravikumar¹, M Voros¹, M. Peralta², A. Ngo², H. Melikan², N. Mirzaee¹, S. Luo¹, A. Kluber¹, N. Jaeckle¹

¹Department of Physics, ²Department of Chemistry, ³Department of Electrical & Computer Engineering, University of California, ⁴Department of Molecular & Cell Biology, University of California, 1 Shields Avenue, Davis CA USA, 95616

*Email: dlcox@ucdavis.edu

Inspired by 1) the nanoscale precision and gorgeous geometry of self assembled DNA origami for templating nanoparticles[1], and 2) the Self-assembly of devices for renewable energy by genetically modifying viral coat proteins of M13 phage[2], our collaboration has embarked upon a new vision of employing modified, naturally occurring beta solenoid proteins (BSPs) to template the growth of nanoparticles for applications in energy and environmental remediation. Protein scaffolds are anticipated to be more robust to variations in temperature and chemical environment than DNA, and offer greater precision and ordering for nanoparticle growth than viral assemblies. We have simulated and produced, through recombinant expression in *E. coli*, modified BSPs with two or three flat sides, and shown that we can turn these into one-dimensional amyloid assemblies as well as laterally assembled two-dimensional structures with predictable heights. We have simulated and developed a theory of twist and twist mitigation of fibrils, and simulated the binding of monomers to understand amyloid and lateral assembly. We are working on modifying the amyloids which hold together bacterial or yeast biofilms for applications in remediation of heavy metals and adsorption of uranium from seawater.

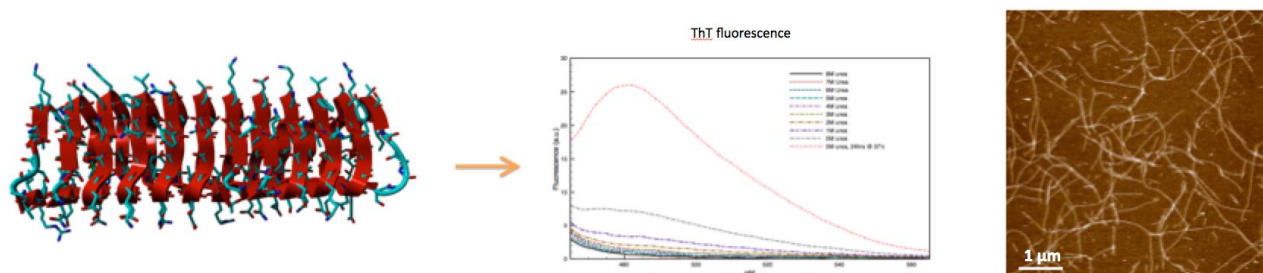


Fig. 1 Left : engineered spruce budworm antifreeze protein. NoDS9M1 Middle : Thioflavin-T fluorescence indicative of amyloid formation for incubated NoDS9M1. Right : AFM images of NoDS9M1 Fibrils

Keywords: amyloid, beta solenoid, nanoparticles, biofilm

- 1 Seeman, N.C., *Nanomaterials Based on DNA*, in *Annual Review of Biochemistry*, Vol 79, R.D. Kornberg, et al., Editors. 2010. p. 65-87.
- 2 Belcher, A.M., B. Peelle, and K.T. Nam, *Multifunctional biomaterials as scaffolds for electronic, optical, magnetic, semiconducting, and biotechnological applications*. 2009, Board of Regents The University of Texas System; Massachusetts Institute of Technology.